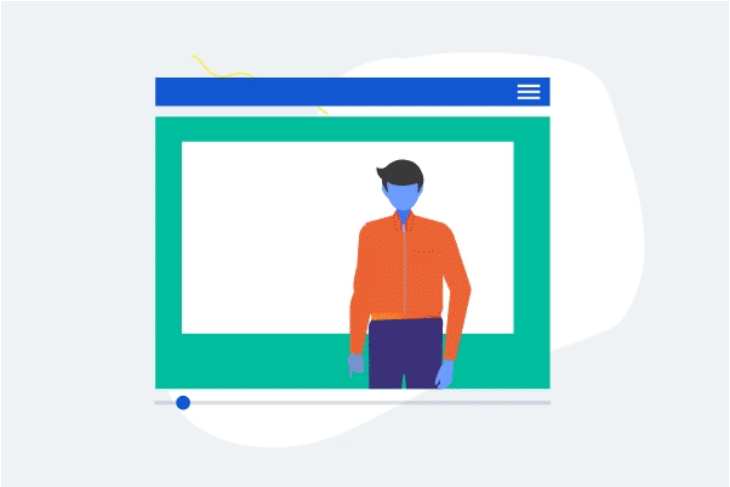


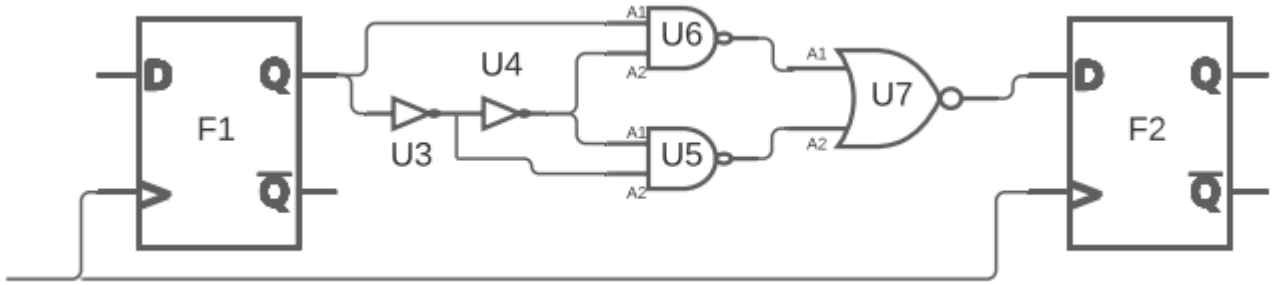
Day3

Running the lab

- Type “cd lab3”
- Run ‘sta run.tcl -noexit | tee out.txt’

Understanding Slack Computation

- Consider the following picture
- How many paths do you see F1:CK →F2:D?
    1. F1:CK→U3→U4→U6:A2→U7:A1→F2:D
    2. F1:CK→U6→U4→U5:A1→U7:A2→F2:D
    3. F1:CK→U6:A1→U7:A1→F2:D
    4. F1:CK→U6→U5:A2→U7:A2→F2:D
- Type ‘leafpad out.txt’ the slack reported for the path is -217.323
- Which of the 4 paths above it corresponds to

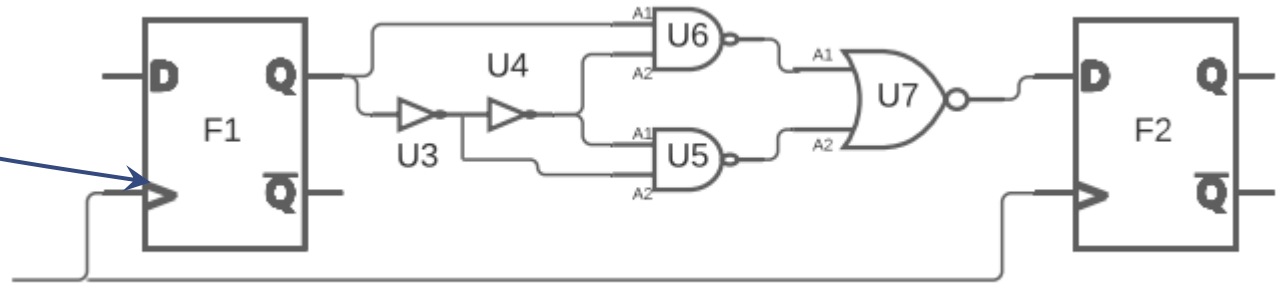


Understanding Slack Computation

```
Startpoint: F1 (rising edge-triggered flip-flop clocked by clk_net)
Endpoint: F2 (rising edge-triggered flip-flop clocked by clk_net)
Path Group: clk_net
Path Type: max

  Delay    Time   Description
---------------------------------------------------------
   0.00    0.00   clock clk_net (rise edge)
   0.00    0.00   clock network delay (ideal)
   0.00    0.00 ^ F1/CK (DFFR_X2)
 141.53  141.53 ^ F1/Q (DFFR_X2)
   8.51  150.04 v U3/ZN (INV_X1)
   7.82  157.86 ^ U4/ZN (INV_X1)
   6.63  164.49 v U5/ZN (NAND2_X2)
  23.62  188.10 ^ U7/ZN (NOR2_X1)
   0.00  188.10 ^ F2/D (DFFR_X2)
         188.10   data arrival time

   1.00    1.00   clock clk_net (rise edge)
   0.00    1.00   clock network delay (ideal)
   0.00    1.00   clock reconvergence pessimism
           1.00 ^ F2/CK (DFFR_X2)
 -30.22  -29.22   library setup time
         -29.22   data required time
---------------------------------------------------------
         -29.22   data required time
        -188.10   data arrival time
---------------------------------------------------------
        -217.32   slack (VIOLATED)
```

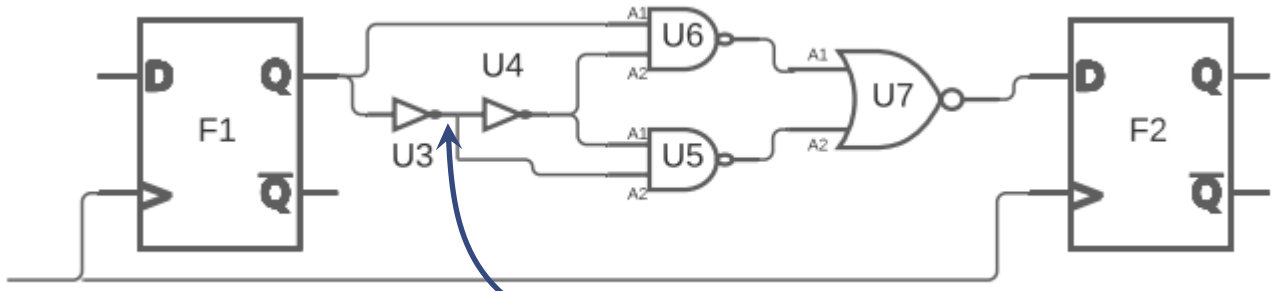


Understanding Slack Computation

```
Startpoint: F1 (rising edge-triggered flip-flop clocked by clk_net)
Endpoint: F2 (rising edge-triggered flip-flop clocked by clk_net)
Path Group: clk_net
Path Type: max

  Delay    Time   Description
---------------------------------------------------------
   0.00    0.00   clock clk_net (rise edge)
   0.00    0.00   clock network delay (ideal)
   0.00    0.00 ^ F1/CK (DFFR_X2)
 141.53  141.53 ^ F1/Q (DFFR_X2)
   8.51  150.04 v U3/ZN (INV_X1)
   7.82  157.86 ^ U4/ZN (INV_X1)
   6.63  164.49 v U5/ZN (NAND2_X2)
  23.62  188.10 ^ U7/ZN (NOR2_X1)
   0.00  188.10 ^ F2/D (DFFR_X2)
         188.10   data arrival time

   1.00    1.00   clock clk_net (rise edge)
   0.00    1.00   clock network delay (ideal)
   0.00    1.00   clock reconvergence pessimism
           1.00 ^ F2/CK (DFFR_X2)
 -30.22  -29.22   library setup time
         -29.22   data required time
---------------------------------------------------------
         -29.22   data required time
        -188.10   data arrival time
---------------------------------------------------------
        -217.32   slack (VIOLATED)
```

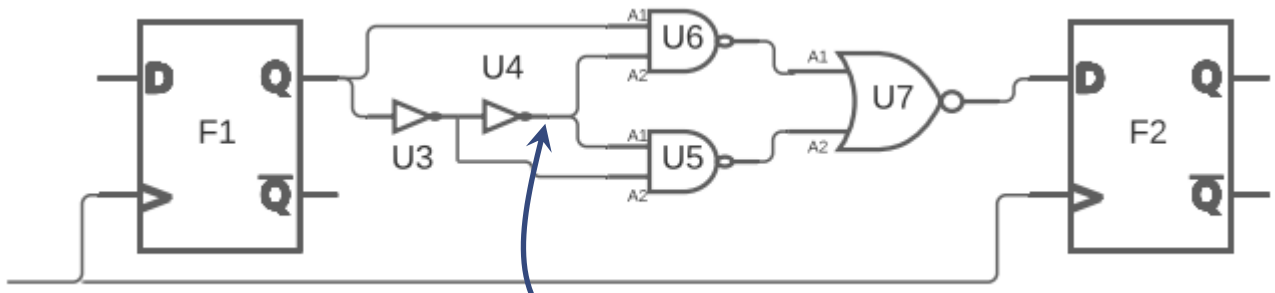


Understanding Slack Computation

```
Startpoint: F1 (rising edge-triggered flip-flop clocked by clk_net)
Endpoint: F2 (rising edge-triggered flip-flop clocked by clk_net)
Path Group: clk_net
Path Type: max

  Delay    Time   Description
---------------------------------------------------------
   0.00    0.00   clock clk_net (rise edge)
   0.00    0.00   clock network delay (ideal)
   0.00    0.00 ^ F1/CK (DFFR_X2)
 141.53  141.53 ^ F1/Q (DFFR_X2)
   8.51  150.04 v U3/ZN (INV_X1)
   7.82  157.86 ^ U4/ZN (INV_X1)
   6.63  164.49 v U5/ZN (NAND2_X2)
  23.62  188.10 ^ U7/ZN (NOR2_X1)
   0.00  188.10 ^ F2/D (DFFR_X2)
         188.10   data arrival time

   1.00    1.00   clock clk_net (rise edge)
   0.00    1.00   clock network delay (ideal)
   0.00    1.00   clock reconvergence pessimism
           1.00 ^ F2/CK (DFFR_X2)
 -30.22  -29.22   library setup time
         -29.22   data required time
---------------------------------------------------------
         -29.22   data required time
        -188.10   data arrival time
---------------------------------------------------------
        -217.32   slack (VIOLATED)
```

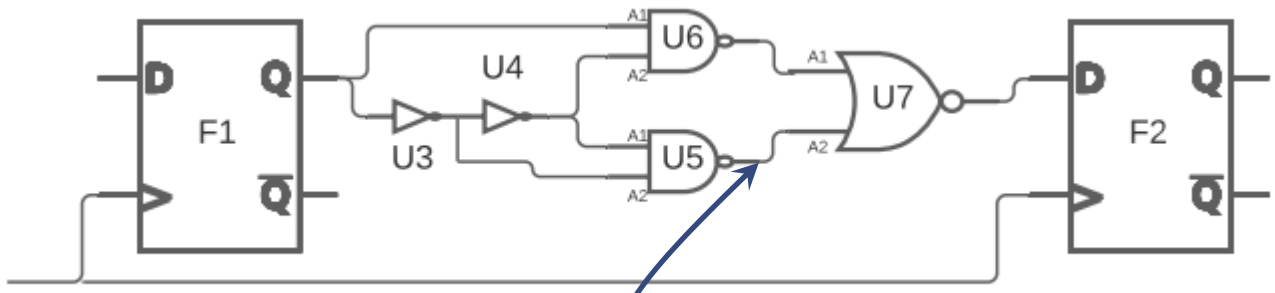


Understanding Slack Computation

```
Startpoint: F1 (rising edge-triggered flip-flop clocked by clk_net)
Endpoint: F2 (rising edge-triggered flip-flop clocked by clk_net)
Path Group: clk_net
Path Type: max

  Delay    Time   Description
---------------------------------------------------------
   0.00    0.00   clock clk_net (rise edge)
   0.00    0.00   clock network delay (ideal)
   0.00    0.00 ^ F1/CK (DFFR_X2)
 141.53  141.53 ^ F1/Q (DFFR_X2)
   8.51  150.04 v U3/ZN (INV_X1)
   7.82  157.86 ^ U4/ZN (INV_X1)
   6.63  164.49 v U5/ZN (NAND2_X2)
  23.62  188.10 ^ U7/ZN (NOR2_X1)
   0.00  188.10 ^ F2/D (DFFR_X2)
         188.10   data arrival time

   1.00    1.00   clock clk_net (rise edge)
   0.00    1.00   clock network delay (ideal)
   0.00    1.00   clock reconvergence pessimism
           1.00 ^ F2/CK (DFFR_X2)
 -30.22  -29.22   library setup time
         -29.22   data required time
---------------------------------------------------------
         -29.22   data required time
        -188.10   data arrival time
---------------------------------------------------------
        -217.32   slack (VIOLATED)
```

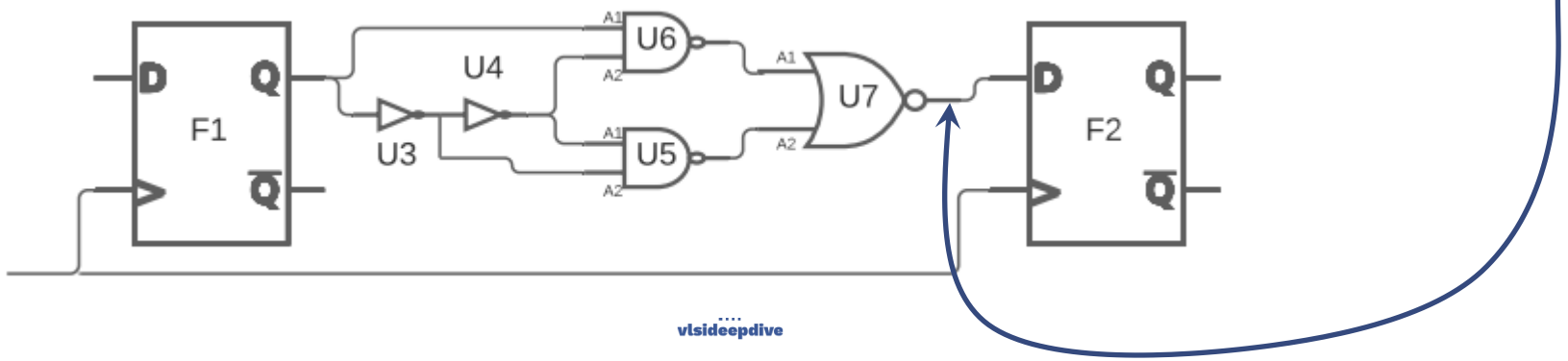


Understanding Slack Computation

```
Startpoint: F1 (rising edge-triggered flip-flop clocked by clk_net)
Endpoint: F2 (rising edge-triggered flip-flop clocked by clk_net)
Path Group: clk_net
Path Type: max

  Delay    Time   Description
---------------------------------------------------------
   0.00    0.00   clock clk_net (rise edge)
   0.00    0.00   clock network delay (ideal)
   0.00    0.00 ^ F1/CK (DFFR_X2)
 141.53  141.53 ^ F1/Q (DFFR_X2)
   8.51  150.04 v U3/ZN (INV_X1)
   7.82  157.86 ^ U4/ZN (INV_X1)
   6.63  164.49 v U5/ZN (NAND2_X2)
  23.62  188.10 ^ U7/ZN (NOR2_X1)
   0.00  188.10 ^ F2/D (DFFR_X2)
         188.10   data arrival time

   1.00    1.00   clock clk_net (rise edge)
   0.00    1.00   clock network delay (ideal)
   0.00    1.00   clock reconvergence pessimism
           1.00 ^ F2/CK (DFFR_X2)
 -30.22  -29.22   library setup time
         -29.22   data required time
---------------------------------------------------------
         -29.22   data required time
        -188.10   data arrival time
---------------------------------------------------------
        -217.32   slack (VIOLATED)
```

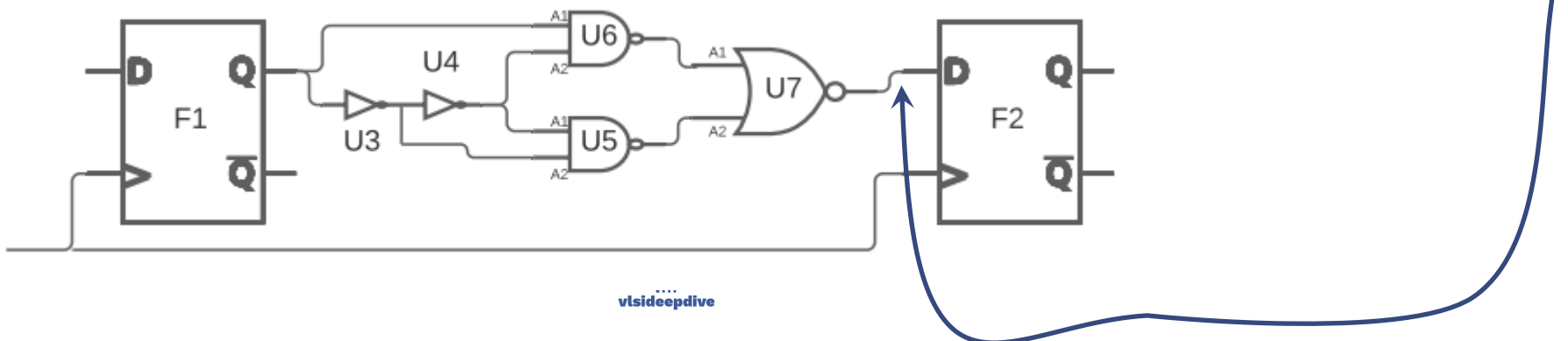


Understanding Slack Computation

```
Startpoint: F1 (rising edge-triggered flip-flop clocked by clk_net)
Endpoint: F2 (rising edge-triggered flip-flop clocked by clk_net)
Path Group: clk_net
Path Type: max

  Delay    Time   Description
---------------------------------------------------------
   0.00    0.00   clock clk_net (rise edge)
   0.00    0.00   clock network delay (ideal)
   0.00    0.00 ^ F1/CK (DFFR_X2)
 141.53  141.53 ^ F1/Q (DFFR_X2)
   8.51  150.04 v U3/ZN (INV_X1)
   7.82  157.86 ^ U4/ZN (INV_X1)
   6.63  164.49 v U5/ZN (NAND2_X2)
  23.62  188.10 ^ U7/ZN (NOR2_X1)
   0.00  188.10 ^ F2/D (DFFR_X2)
         188.10   data arrival time

   1.00    1.00   clock clk_net (rise edge)
   0.00    1.00   clock network delay (ideal)
   0.00    1.00   clock reconvergence pessimism
           1.00 ^ F2/CK (DFFR_X2)
 -30.22  -29.22   library setup time
         -29.22   data required time
---------------------------------------------------------
         -29.22   data required time
        -188.10   data arrival time
---------------------------------------------------------
        -217.32   slack (VIOLATED)
```



Exercises

- Change the number of paths being reported to 100
  - report_checks –from F1/CK -endpoint_count 100
  - Analyze each path in detail and understand